DISC-MEMORY SYSTEMS

GENERAL PRECISION, INC., LIBRASCOPE GROUP

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LIBRASCOPE

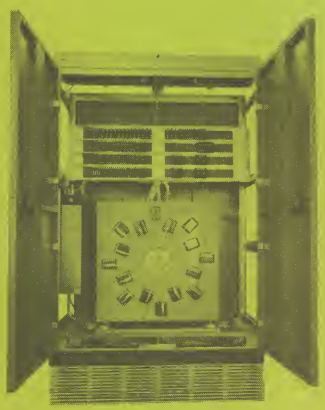
Small, Medium, and Militarized **DISC-MEMORY SYSTEMS**

For Industry and Manufacturing
Military Applications
Science and Engineering
Government Agencies
Financial Institutions
Retail Trade and Distribution

GENERAL PRECISION, INC., LIBRASCOPE GROUP

Low-cost L100 disc memories

Technician assembles L210 disc memory



Large-capacity L424 disc memory

L507M militarized disc memory

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DISC-MEMORY SYSTEMS

Small, Medium, and Militarized Magnetic-Disc Memories For

Industry and Manufacturing
Military Applications
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Librascope Disc-Memory Systems are a family of high-speed, random-access, magnetic-disc memories, available in military and industrial versions. They include small-capacity, medium-capacity, and militarized models:

- Series L100: inexpensive memories with capacities to 300,000 bits.
- Series L200: low cost, high performance memories with capacities to 2 million bits.
- Series L400: versatile, high performance memories with capacities to 50 million bits. (In addition large-scale mass memories with capacities to 400 million bits and beyond are available from Librascope's Systems Division.)
- Militarized memories, in a wide variety of configurations, to meet the most rigid requirements.

Librascope disc memories are used in a wide variety of applications as the primary memory, for buffer storage, or to supplement other memories in such typical installations as:

Hospitals

Public Utilities

Military Installations

Insurance Firms

Low-cost disc memory used in commercial computer

Disc memory stores credit-checking data

- Government Agencies
- Banks
- Chemical Process Industries
- Retail Stores
- Manufacturing Industries
- Distributors
- Scientific and Engineering Laboratories

for such uses as:

- Billing
- Account Status
- Inventory Control
- Process Control
- Checkout Systems
- Data Handling and Processing
- Scientific and Engineering Programs

and provide such additional support capability as:

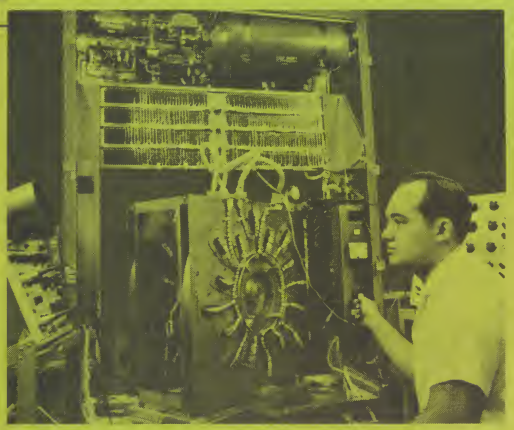
- Report Program Generator
- Sorting
- Systems Monitor
- Complete Set of Utilities

Librascope offers the most comprehensive line of disc memories in the computer industry. Discs range in size from $6^1/_4$ in. diameter to 24 in. diameter. (Librascope's mass memories use 38 in. and 48 in. discs.) One, two, or more discs may be utilized in a memory system.

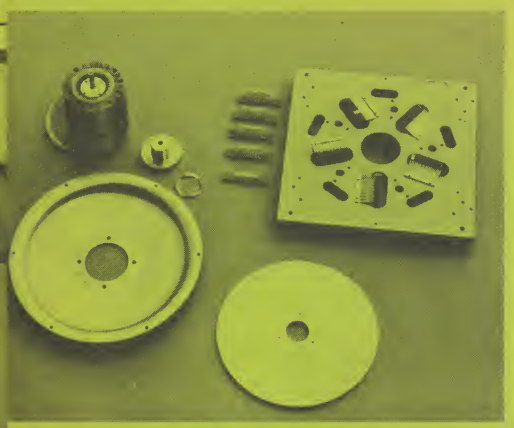
Militarized disc memory installed aboard submarine

Versatile Librascope memories use discs from $6^1/_4$" to 24" in diameter and beyond

Volume production helps attain low-cost memories



System reliability is stressed during checkout



Quality components and simple construction enhance reliability

FEATURES

The outstanding performance of Librascope Disc-Memory Systems is the result of advanced design and quality construction of magnetic discs, electronics, structures, and operating mechanisms. Some of the features that contribute to this high level of performance are:

LOW-COST DATA STORAGE

Librascope disc memories provide remarkably low-cost-per-bit data storage. In Series L100 models, simplified design and volume production make possible 30,000-bit units priced as low as $1000. In larger models, packing densities as high as 2,000 bits per inch result in storage at less than 0.06¢ per bit.

VERSATILITY

Librascope disc memories may be used with virtually any computer system, peripheral equipment, or other system — either as "original equipment" in new systems, or as "add on equipment" to enlarge the capacity and expand the usefulness of existing systems. They are equally adaptable to use as the central or primary memory, as buffer storage, or as supplements to other memories. Although usually purchased as complete memory systems that include magnetic discs, read/write heads, associated electronics and drive motor, the individual magnetic disc memory modules also are available. Most models are designed to mount in standard 19″ racks.

HIGH RELIABILITY

The advanced, yet simplified, design of magnetic disc memories and associated electronics, together with the use of highest quality materials, the latest manufacturing techniques, and rigid quality control procedures, assure the high reliability of Librascope disc memories. Flying, air-

floated read/write heads and smooth, fine-grain, hard plated-cobalt disc surfaces reduce wear to a minimum. The basic structure utilizes materials, close tolerance, and design proportions selected to compensate for the temperature differentials encountered in storage and operation. Discs and supporting structures are of aluminum, for maximal strength, rigidity, and lightness. Librascope disc memory reliability is maintained by rigid quality control and a careful checkout procedure. In the Series L400 units, for example, a typical acceptance criterion requires no errors in 10^{11} bits of data transfer.

HIGH-SPEED RANDOM ACCESS

Average access time ranges from less than 4 milliseconds to 25 milliseconds, depending on disc diameter and rotation speed.

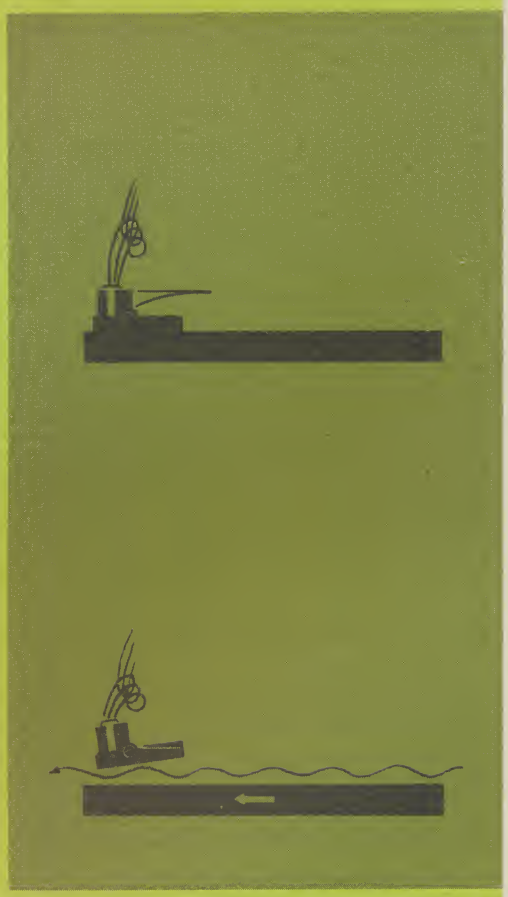
HEAD PER TRACK

Librascope disc memories feature the use of one read/write head for each recording track. This straightforward design concept obviates the need for a complex and cumbersome head-positioning mechanism, saving weight and space as well as improving reliability. Head-per-track design enhances such characteristics as access time, programming ease, and organizational flexibility.

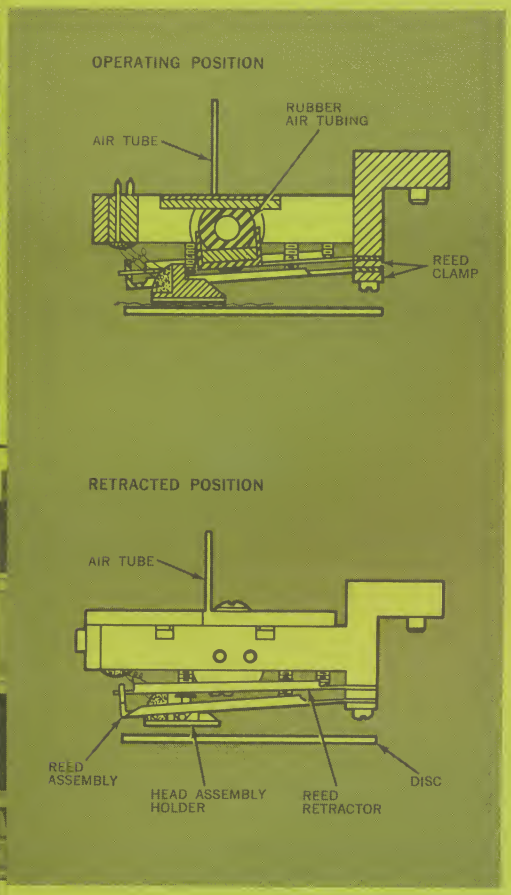
FLYING HEADS

Librascope disc memories incorporate the well-proved flying-head concept: the read/write heads float on a thin cushion of air while the disc is rotating. The aerodynamically balanced heads are of advanced design, structurally and electronically. In Series L400 units, they are mounted 16 to a head bar, with spare heads and timing heads mounted similarly. In Series L100 and Series L200 units, each head is mounted individually.

Close-up of L400 disc memory head bar shows head-per-track configuration



Positions of flying heads — disc at rest, disc rotating



Automatic head-retractor mechanism shown in operating (upper) and retracted (lower) positions

Control panel provides centralized control

AUTOMATIC HEAD RETRACTOR MECHANISM

Most memories incorporate the Librascope-developed Automatic Head Retractor Mechanism that keeps read/write heads away from the surface of the disc *at all times.* (Series L100 and L200 individual head units do not require head retraction.) This prevents any wear on heads and disc that ordinarily results when they are in contact during start-up and slow-down of the disc. When the disc is not rotating a set of retracting reeds, under the proper preloaded tension, pulls the heads away from the surface of the disc. When the disc attains operating speed, a pressurization system forces a flow of inert gas to the head assemblies, counteracting the force of the reeds, and moving the heads to their aerodynamic, air-floated position just above the surface of the disc (see drawing). When the disc slows down, the fail-safe pressurization system is deactivated; the retracting reeds pull the heads away from the surface of the disc.

SELF-CLOCKING

Series L400 memories are available with self-clocking provisions developed by Librascope that afford a high bit packing density combined with high readback reliability. This self-clocking technique synchronizes readback data with a pre-recorded data pattern, then resynchronizes the readback data with the system's master clock.

CONTROL PANEL

With large disc memory systems, a control panel often is furnished to provide centralized monitoring and control facilities. This panel usually includes (1) DC power on-off switch and indicator light; (2) DC circuit breakers; (3) DC voltmeter to indicate all DC voltages; (4) unit operable indicator light; (5) AC power on-off switch and indicator light; (6) AC circuit breakers; (7) high-temperature warning indicators; (8) pneumatic system pressure gauges and indicator lights.

"ADD ON" CAPABILITY

Librascope disc memories provide "add on" capability in the field. Capacity of the entire system may be enlarged at any time simply by adding the appropriate disc memories. Capacity of already installed disc memories, that are not utilizing their full capacity, may be increased by adding read/write heads and associated electronics whenever needed. Thus the computer designer is provided "field-expandable memory capacity."

COBALT PLATED RECORDING SURFACE

Outstanding magnetic qualities are provided by the Librascope-developed electroless plated-cobalt disc coating. The super finish and exceptionally hard surface resist abrasion and accidental damage, and contribute greatly to long, trouble-free disc life.

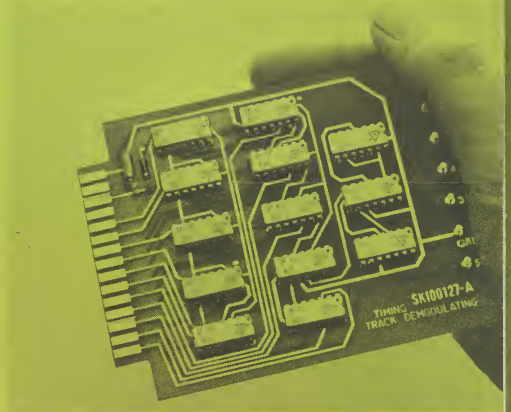
INTEGRATED CIRCUITRY

In Series L400 memories, silicon monolithic integrated circuits form the great majority of system electronics; only the read/write amplifiers and selection drivers incorporate some discrete components. Digital circuits utilize transistor-to-transistor logic (T^2L) for reliability and speed. The chips are packaged "in line", which affords easy handling and allows flow soldering.

EASE OF MAINTENANCE

Librascope disc memories are specifically designed for easy maintenance. Both surfaces of every disc are in easy reach. Read/write heads are easy to add or to replace. Spare heads are stored right where they will be used, needing only to be wired. Electronics are plug-in modules. Most disc modules and electronics modules mount in standard 19″ racks, and can be repackaged to fit customer-specified envelopes.

Librascope discs are coated in one of world's finest plating facilities



Integrated circuits in L400 memories reduce size, cost

Librascope disc memories feature easy access and maintenance

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SERIES L100
DISC-MEMORY SYSTEMS
—for Inexpensive Data Storage

Technician assembles L100 disc memory

L100 disc memories in final stage of production

More than 500 L100 memories have been produced

The Series L100 is the new designation for an expanded line of the popular Model L321 memory, 500 of which have already been sold. The Series L100 Disc-Memory Systems provide inexpensive data storage for applications requiring 30,000 to 300,000 bit capacities. Economy is achieved by simplified design and volume production, never by sacrificing any of Librascope's traditionally high quality or quality control standards.

APPLICATIONS

Typical uses of Series L100 memories are in automatic checkout systems for integrated circuit testing; systems that give quick readings on the status of checking accounts to bank tellers, on the status of charge accounts to store clerks, on the status of insurance accounts or magazine subscriptions; license information about stolen automobiles, etc.

FEATURES

Series L100 memories offer all the features that contribute to the outstanding performance of every Librascope Disc-Memory System, as described on earlier pages. Recording is on one side of a single 10″ disc. Up to 49 tracks of data may be recorded, with a maximum recording density of 400 bits per inch. Where low cost is a prime consideration, and capacity need not exceed 100,000 bits, densities as low as 150 bits per inch may be specified.

The Librascope-manufactured flying heads used with Series L100 memories are similar to those used with the high-performance Series L200 and L400 memories. For economy, however, Series L100 heads are mounted individually, rather than on head bars as in the Series L400.

SPECIFICATIONS — LIBRASCOPE SERIES L100 DISC MEMORIES

	Minimum-Performance Configuration	Maximum-Performance Configuration
Capacity, bits	30,000	300,000
Access time, milliseconds, average	25	8
Magnetic discs: Number Recording surfaces Diameter, inches Rotation speed, rpm	 1 1 10 1200	 1 1 10 3600
Recording heads	4	49
Data bits per inch	150	400
Dimensions, inches (W x H x D)	13 x 13 x 7	13 x 13 x 7
Weight, pounds, approx.	25	25
Power required	115 volts, 60 cycle, single phase AC	115 volts, 60 cycle, single phase AC

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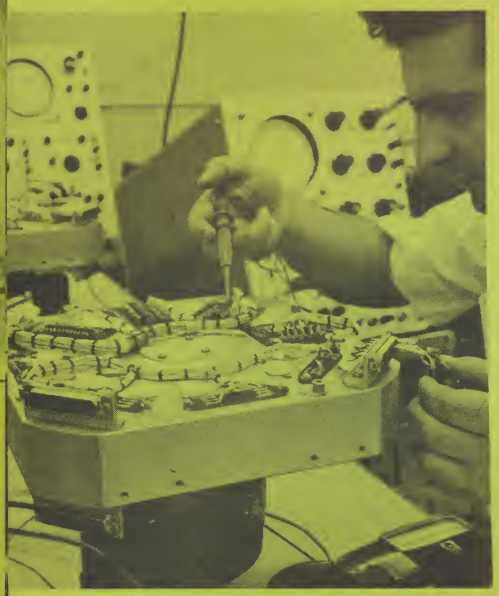
SERIES L200
DISC-MEMORY SYSTEMS

—Low-Cost, High-Performance, Small-to-Medium-Capacity Units



L200 disc memory during final assembly

L200 memory, low in cost and high in capacity

Librascope Series L200 Disc-Memory Systems are low-cost, high-performance units with capacities from 30,000 to 2 million bits. They are designed for applications that require a high level of performance, yet do not require more than moderate capacity for the primary memory. Capacity can be increased at any time, either by adding recording heads and associated electronics to memories that have not been utilized to full capacity.

APPLICATIONS

Typical uses are in inventory control systems; process control systems; large-volume bank account, credit card, or charge account systems; or any data handling or data processing system that requires up to 2 million bits capacity. Particularly when capacity is utilized fully, Series L200 magnetic disc memories provide remarkably low-cost-per-bit data storage.

FEATURES

Series L200 memories offer all the features that contribute to the outstanding performance of every Librascope Disc-Memory System, as described on earlier pages. Recording is on one or both sides of a single disc. Up to 128 tracks of data may be recorded, with a maximum recording density of 1000 bits per inch. Where only small capacities are required now, and it is not expected that larger capacities will be required in the future, densities as low as 300 bits per inch may be specified.

The Librascope-manufactured flying heads used with Series L200 memories are similar to those used with Series L400 units. The smaller number of heads used in the Series L200, however, makes it more practical to mount them individually, rather than on head bars as in the Series L400.

SPECIFICATIONS — LIBRASCOPE SERIES L200 DISC MEMORIES

	Minimum-Performance Configuration	Maximum-Performance Configuration
Capacity, bits	30,000	2,000,000
Access time, milliseconds, average	25	8
Magnetic discs: Number Recording surfaces Diameter, inches Rotation speed, rpm	 1 1 10 1200	 1 2 10 3600
Recording heads	4	128
Data bits per inch	300	1000
Dimensions, inches (W x H x D)	13 x 13 x 9¾	13 x 13 x 9¾
Weight, pounds, approx.	35	35
Power required	115 volts, 60 cycle, single phase AC	115 volts, 60 cycle, single phase AC

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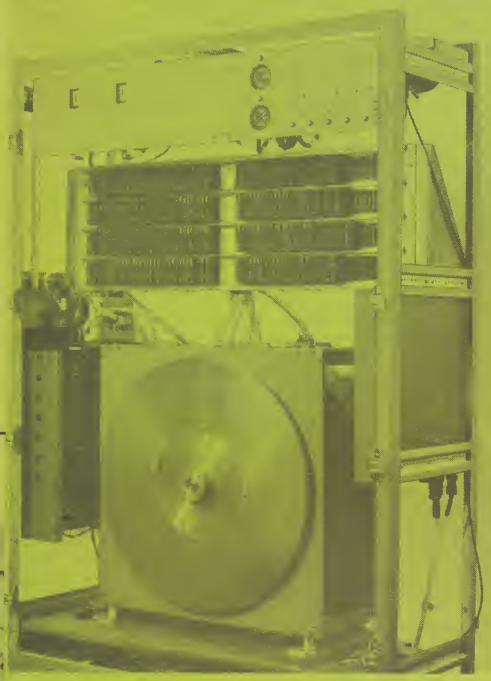
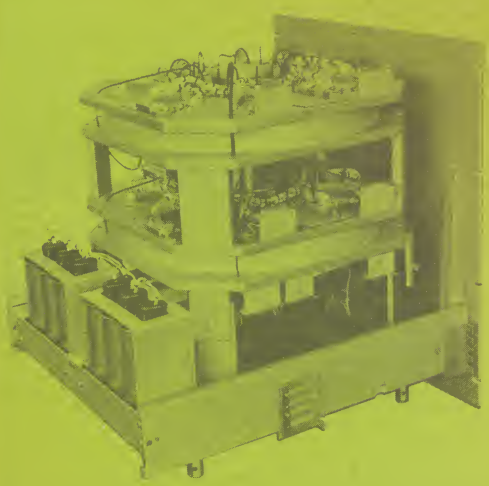
SERIES L400
DISC-MEMORY SYSTEMS

—High-Performance, Medium-Large Capacity Units



L424 memory features large discs (24″ in diameter) and complete electronics

L400 head plate reveals head-per-track arrangement



Large-capacity L414 memory

Librascope Series L400 Disc-Memory Systems are high-performance units with capacities of 3 million to 50 million bits. Large disc diameters and high recording densities combine to provide extremely low-cost-per-bit data storage; this is particularly true for the medium-large capacity units. Capacity can be increased at any time, either by adding recording heads and associated electronics to memories that have not been utilized to full capacity, or by adding discs and electronics to existing systems.

APPLICATIONS

Series L400 memories include both military and industrial versions, and are applicable to any data handling or data processing situation that requires both large capacity and outstanding performance.

FEATURES

Series L400 memories offer all the features that contribute to the outstanding performance of every Librascope Disc-Memory System, as described on earlier pages. Features available in the Series L400 that are *not* available in the others include the Automatic Head Retractor Mechanism that keeps the recording heads away from the surface of the disc *at all times,* thus preventing the wear on heads and discs that ordinarily results if they are in contact. Silicon monolithic integrated circuitry is utilized in the Series L400, with its attendant benefits of high-performance capabilities, space-saving, and cost reduction.

SPECIFICATIONS — LIBRASCOPE L400 DISC MEMORIES

	Minimum-Performance Configuration	Maximum Performance Configuration
Capacity, bits	3,000,000	50,000,000
Access time, milliseconds, average	35	8
Magnetic discs:		
Number	1	2
Recording surfaces	1	4
Diameter, inches	9	24
Rotation speed, rpm	900	3600
Recording heads	512	1024
Data bits per inch	600	1500
Error rate, typical	One error in 10^{11} bits	One error in 10^{11} bits
Logic levels	Zero: 0 volts One: +2.5 volts	Zero: 0 volts One: +2.5 volts
Electronics	Integrated circuit transistor-to-transistor logic (T^2L)	Integrated circuit transistor-to-transistor logic (T^2L)
Dimensions, inches (W x H x D)	15 x 15 x 14	26 x 27 1/4 x 13
Weight, pounds, approx.	90	
Power required:		
Discs	230 volts, 60 cycle, 3-phase AC	230 volts, 60 cycle, 3-phase AC
Electronics	DC: +5 volts, −5 volts, +12 volts	DC: +5 volts, −5 volts, +12 volts

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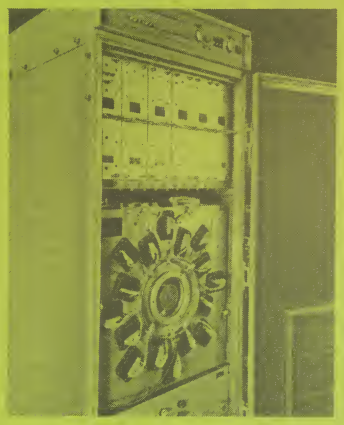
DISC-MEMORY SYSTEMS

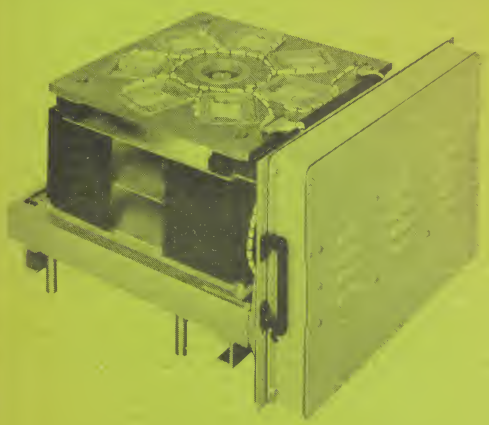
—High-Reliability Performance in Extreme Environments

L507M memory is compact, sturdy



L524M installed aboard ship

L508M memory in fieldable computer



L514M1 memory fits into standard rack

Librascope Militarized Disc-Memory Systems provide high-reliability performance in extreme environments. They are available in configurations to meet virtually any requirement for airborne, spaceborne, shipboard, fieldable, or ground-based data systems. Capacities range from a few thousand bits to 50 million bits.

Typical of the great variation currently available in Librascope's standard line of militarized disc memories are these recently designed systems:

- L508M, for off-line data buffering. This compact unit has a capacity of 500,000 bits. A typical application for the L508M is for program storage for an aircraft weapons tester. This system requires operation under all weather conditions including temperatures as low as —45°C.
- L514M1, for buffer unit interim storage. Data is stored in "message blocks" in the L514M1 memory, which is part of a Univac Input/Output Buffer Console in the Air Force's Mobile Wing Reconnaissance Technical Computer System. The buffer console occupies one of seven "huts," that can be dropped from helicopters.
- L507M, for military and space applications. Capacity is in excess of 1 million bits, yet it weighs only 11 lbs. and measures only $7^1/_4 \times 7^1/_4 \times 5''$. Both the memory element — a $6^1/_4''$ diameter disc storing data on both sides — and the associated electronics are contained in the single package. Meets or exceeds the requirements of Mil-E-5400G Class II. Data can be written or read in series or parallel format; the number of parallel bits is limited only by the size of the disc, or by the requirements of the data processor.

• L514M2, for mobile trailer applications. This 2 million bit unit serves as the primary memory in a mobile-trailer-mounted computer, subject to severe vibration. Organization is 32,768 words of 60 bits each in 256 data tracks (128 groups of 2); each word is recorded as 30 serially recorded characters of 2 bits in parallel.

• L524M, for shipboard use in Navy Technical Data Systems (NTDS). Capacity is 25 million bits; average access time is 25 milliseconds. Data storage is on both sides of two 24″ discs. Only 10 lines are required for interface. Both the rotating element and associated electronics are housed in a single cabinet. Construction is modular; all modules are accessible and can be fully maintained from the front of the cabinet.

SPECIFICATIONS — LIBRASCOPE MILITARIZED DISC MEMORIES

	L508M	L514M1	L507M	L514M2	L524M
Capacity, bits	500,000	1,000,000	1,000,000	2,000,000	25,000,000
Access time, milliseconds, average	4	12	4	7.5	25
Magnetic discs:					
Number	1	1	1	2	2
Recording surfaces	1	1	2	3	4
Diameter, inches	8	14	6¼	14	24
Rotation speed, rpm	5000	3000	8000	4000	1200
Recording heads	18	109	120	288	1024
Data bits per inch	150	410	955	300	624
Error rate, typical	one error in 10^{11} bits	one error in 10^{11} bits		one error in 10^{11} bits	
Logic levels		Zero: 0 volts One: −4.5 volts		Zero: 0 volts One: +6 volts	
Electronics		CP-789-compatible (Univac 1218; 32 interface lines)		62 interface lines	CP-789-compatible (Univac 1218 Fast NTDS)
Dimensions, inches (H x W x D)	10 x 10 x 7	18 x 10 x 18	7¼ x 7¼ x 5	19 x 17 x 19	26 x 29½ x 72
Weight, pounds, approx.	25	91	11	150	280
Power required:					
Discs	115 volts, 400 cycle, single phase AC	115 volts 400 cycle, 3-phase AC	105/108 volts, 400 cycle, 3-phase AC	115 volts, 400 cycle, 3-phase AC	120/208 volts, 60 cycle, 3-phase AC
Electronics		+15 volts; −15 volts −4.5 volts DC		+28 volts; +15 volts −15 volts DC	120 volts; 60 cycle; single phase AC

Librascope engineers always are available to discuss your computer memory requirements, and to assist in the application of disc memories to your systems. Librascope's long experience and broad capabilities in the design and production of computers, computer memories, and data processing systems afford a reservoir of knowledge that is at your service.

General Precision/Librascope is an important member of the General Precision Equipment Corp. family of companies. Librascope's present capabilities and potential future growth are enhanced thereby.

General Precision Equipment Corp. has over 20,000 employees in 40 major plant locations in the United States and abroad, utilizing more than 4 million square feet of plant space. Annual sales of the Corporation's subsidiaries total in excess of $350 million.

Librascope Components Division products:
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